

Diversity of flora in the undergrowth of park afforestations, rural plantings and oak-hornbeam forests

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ABSTRACT

The process of forest fragmentation has been observed in many countries, where plant species had adapt to different habitats, such as for example manor parks and rural plantings. A number of scientists have studied the parks as sites where waning environments and landscapes find their shelter. In 2011–2012, research was undertaken on diversity of vegetation in afforestations of parks, rural plantings and oak-hornbeam forests in Sandomierz Basin. In order to compare the means obtained univariate analysis of variance (one-way ANOVA) was used with juxtaposing divided by each of the two criteria: size (the small, and large parks) and conservation (cultivated parks and noncultivated parks). Tukey's test was used to examine the significance of differences between respective groups. Analyses were with STATISTICA 9.1. software. Plants classified as forest species, grassland species and those of synanthropic communities were observed in all the afforestations. The parks with high wooded and not mowed areas and oak-hornbeam forests were more forest-like than other types of afforestations studied.

KEY WORDS

undergrowth, flora, park, rural plantings, forest

INTRODUCTION

Manor parks are an essential element of Poland's countryside landscape. Because of their origin they are perceived as landscape relicts with important architectural, ecological and natural values. Several scientists have studied the parks as places where waning environments and landscapes find their shelter. The studies concerning rural parks most often include the issues related to dendrological inventory, afforestation

shaping, the history of manor park ownership, condition of park objects, cultural values and functions as well as they provide recommendations on the protection and restoration of park areas. There are no studies concerning environmental effects on the form of manor park vegetation. The aim of this study was to determine flora diversity in the undergrowth of: park afforestations, rural plantings and oak-hornbeam forests. Also, the study sought for the answers to specific research questions:

- Is there a correlation of vegetation between the size of park's state of forestation and stand composition in relation to rural plantings and oak-hornbeam forests?
- Is plant species composition equivalent in rural parks, mid-field tree stands and forest communities in the same oak-hornbeam habitat?

MATERIAL AND METHODS

In 2011–2012, the study was undertaken on diversity of vegetation in afforestations of manor parks, rural plantings and oak-hornbeam forests situated within Sandomierz Basin. Of more than 100 landscape-stylized manor parks, 34 objects were selected and distinguished according to the following criteria: the size of forested area and frequency of mowing of the undergrowth in afforestations. Study objects are located within habitats of oak-hornbeam forests (*Tilio-Carpinetum*) of Little Poland-vicariant in 34 rural communities in the Land of Sandomierz Basin. Manor parks were divided into two groups in reference to wooded area surface, based on distinguishing between large parks (with an area of afforestation larger than 5 ha) and small parks (with less than 5 ha afforestation area).

Using Braun-Blanquet's method phytosociological records were made in manor park areas which had been forested because of neglected or else rare mowing of the undergrowth (300 records each year) and also in rural planting stands as well as in oak-hornbeam forests located in manor parks' closest vicinity (i.e. up to 1 km from rural park borders). Within the period of two years, there were taken 300 phytosociological records using Braun-Blanquet's method in manor park afforestations, 60 records in rural plantings, and 60 records in oak-hornbeam forests. It should be noted, that oak-hornbeam forests are not situated within protected areas. In order to determine diversity of manor park afforestations as well as that in rural planting stands and forest communities, the numbers of species in *Quercus-Fagetum*, *Artemisietum vulgaris* and *Molinio-Arrhenatheretum* classes were compared. In order to compare the mean values obtained, univariate analysis of variance (one-way ANOVA) was used with juxtaposing the parks, which were divided by each of the two criteria: size (the small, and large parks) and conserva-

tion (cultivated parks and noncultivated parks). Tukey's test was used to examine the significance of differences between respective groups. The analyses were performed using STATISTICA 9.1 software.

RESULTS

The results showed that in the undergrowth of manor parks, rural plantings and oak-hornbeam forests, there occurred plant species associated with forests, grasslands and synanthropic communities. The largest share of plants came from fertile-soil broadleaved forests (*Quercus-Fagetum*), grasslands and pastures (*Molinio-Arrhenatheretum*) and synanthropic (*Artemisietum vulgaris*) communities. The largest share of forest species was identified in oak-hornbeam forests and in large neglected park afforestations. Forest species were represented by e.g.: thimbleweed (*Anemone nemorosa* L.), ground elder (*Aegopodium podagraria* L.), yellow star-of-Bethlehem (*Gagea lutea* L.), yellow archangel (*Galeobdolon luteum* Huds.), hollow root (*Corydalis cava* L.) and wood millet (*Milium effusum* L.).

The difference between the numbers of forest species in the four types of objects investigated (large and small park afforestations, rural plantings and forests) were statistically significant ($p = 0.00$). Furthermore, the types differed from each other (there were four distinct homogeneous groups). From grassland and pasture communities (*Molinio-Arrhenatheretum*) there were distinguished plant species such as common dandelion (*Taraxacum officinale*) (FH Wigg.), common self-heal (*Prunella vulgaris* L.) and golden oat grass (*Trisetum flavescens* L.). These plants grew mainly in mid-field wood stands and parks, and their average numbers were utterly different between different types of objects ($p = 0.00$). Wood avens (*Geum urbanum* L.), purple deadnettle (*Lamium purpureum* L.), broad-leaved chervil (*Chaerophyllum aromaticum* L.) and chickweed (*Cerastium sylvaticum* Waldst. & Kit.) were most common synanthropic species, especially in the small parks and rural planting communities. The largest share had species of *Artemisietum vulgaris* class in rural plantings when compared to the parks and forests where their part was smaller ($p = 0.00$).

When comparing the plant cover of large and small parks with oak-hornbeam forests and rural plantings, it

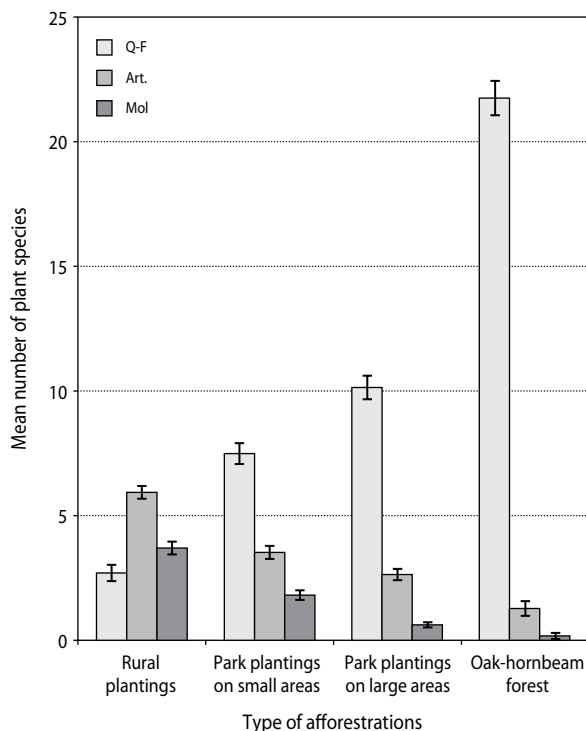


Fig. 1. Number of plant species from *Quercus-Fagetum* in the undergrowth of park afforestations, rural plantings and oak-hornbeam forests

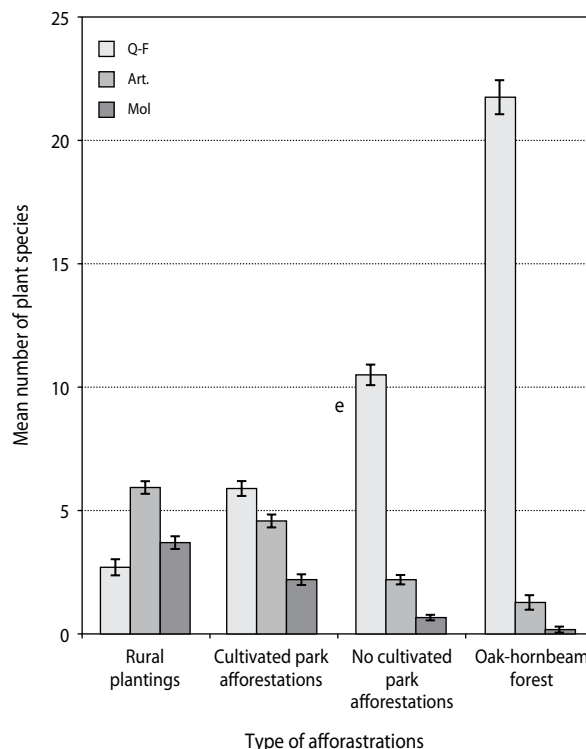


Fig. 2. Number of plant species from *Quercus-Fagetum* (Q-F), *Artemisia vulgaris* (Art) and *Molinia-Arrhenatheretea* (Mol) in the undergrowth of park afforestations, rural plantings and oak-hornbeam forests

was shown that the parks of both groups differed significantly from each other as well as from other areas described with regard to average numbers of species of *Quercus-Fagetum*, *Artemisia vulgaris* and *Molinia-Arrhenatheretea* classes. As a result, the large parks were much more similar to forests, while the small parks resembled rural plantings. Analogous results were obtained by comparison of nurtured parks with neglected ones. Cultivated parks were characteristic of medium quantity of species from all the three classes: *Quercus-Fagetum*, *Artemisia vulgaris* and *Molinia-Arrhenatheretea*, whereas neglected parks resembled forests (fig. 1 and 2).

DISCUSSION

Research on vegetation in rural parks was carried out by Sikorski (2002), Fornal-Pieniak (2007), Fornal-Pieniak and Wysocki (2009a, b, c, d). The composition of plant

species in the afforestations studied reflects the impact of natural as well as anthropogenic factors. In mowed park facilities a larger share of species inconsonant to their natural oak-hornbeam habitat was observed than that in the parks classified as neglected areas, where a share of exogenous species was smaller. Higher frequency and diversity of forest and oak-hornbeam species were observed in large parks with an area of more than 5 hectares. Dzwonko and Loster (1988, 1989), Wójcik (1991), (Honnay et al. 1999b) distinguished natural and anthropogenic factors with impacts on species composition of 'forest islands'. These include for example: the size of the area analyzed, its origin, a type and intensity of human economic activities or else a type of land-use in neighborhood. In this paper, it is proved that mowing of the undergrowth and also the size of forested area are important to diversity of plant species composition in the manor parks observed. The share and frequency of plant species were different in the parks, rural plantings and oak-hornbeam forests.

Fornal-Pieniak's studies on vegetation in the rural parks (2003–2007 and 2011–2012) allowed us to confirm that mowing and the size of forested areas had effects on formation of species composition in park undergrowth. The next stage of research related to a role of manor parks in agricultural landscapes was realized by showing floristic and phytosociological differences and similarities between afforestations in the parks, rural planting stands and oak-hornbeam forests which were located in park nearest vicinity. The results of research showed that forest communities provided best conditions for forest species, well-matched to their natural habitat. The presence of non-forest species in all the studied afforestation types has been also observed in the seed bank. Levenson (1981), Dzwonko and Loster (1992), Godefroid et al. (2006) stated, that in seed banks there were seeds of not only typical forest plant species, but also seeds of plant communities in close proximity to forests. This pilot study shows the floristic and phytosociological diversity of the undergrowth in park afforestations, rural plantings and forests of the agricultural landscape within the area of Sandomierz Basin.

CONCLUSIONS

- The parks with high wooded and not mowed area and oak-hornbeam forests are more forest-like, than other afforestation types. The size of afforestation area and lack of undergrowth mowing have an effect on preservation of greater diversity of plant species in *Quercus-Fagetum* class.
- The size of wooded area has an influence on preserving plant species which are adequate to their natural, oak-hornbeam habitat.
- Less wooded area is more suitable for herbaceous and the synanthropic plant species. This was confirmed by the results of studies that have been conducted in park afforestations and rural planting assemblages.
- Obtained results allow to show floristic and phytosociological differences and similarities between park afforestations, rural plantings and forests in the agricultural landscape of Sandomierz Basin.

REFERENCES

- Braun-Blanquet J. 1951. Pflanzensoziologie, 2 Aufl., Springer Verlag, Wien.
- Dzwonko Z., Loster S. 1988. The number and distribution of vascular plant species in island forest communities in the northern part of the west Carpathian Foothills. *Folia Geobotanica et Phytotaxonomica*, 23, 1–16.
- Dzwonko Z., Loster S. 1989. Distribution of vascular plant species in small woodlands on the western Carpathian foothills. *Oikos*, 56, 77–86.
- Dzwonko Z., Loster S. 1992. Species richness and seed dispersal to secondary woods in southern Poland. *Journal of Biogeography*, 19, 195–204.
- Fornal-Pieniak B. 2007. Szata roślinna parków wiejskich Kotliny Sandomierskiej. Flora of rural parks on example of Sandomierska Valley. *Zeszyty Naukowe Akademii Rolniczej im. H. Kołłątaja w Krakowie*, 444, *Sesja Naukowa*, 92, 223–231.
- Fornal-Pieniak B., Wysocki C. 2009a. Zróżnicowanie florystyczno-fitosocjologiczne warstwy ziół parków wiejskich Krainy Kotliny Sandomierskiej. *Acta Scientiarum Polonorum Formatio Circumiectus*, 8 (1/2), 1–12.
- Fornal-Pieniak B., Wysocki C. 2009b. Przekształcenia szaty roślinnej parków wiejskich w Kotlinie Sandomierskiej. *Acta Scientiarum Polonorum Formatio Circumiectus*, 8 (1/2), 12–20.
- Fornal-Pieniak B., Wysocki C. 2009c. Typy parków wiejskich w krajobrazie rolniczym na przykładzie Krainy Kotliny Sandomierskiej. *Woda-Środowisko-Obszary Wiejskie*, 9 (2), 51–57.
- Fornal-Pieniak B., Wysocki C. 2009d. Diversity of ancient forest plant species in country parks. *Annals of Warsaw University of Life Sciences – SGGW, Horticulture and Landscape Architecture*, 30, 201–205.
- Godefroid S., Phartyal S.S., Koedam N. 2006. Depth distribution and composition of seed banks under different tree layers in a managed temperate forest ecosystem. *Acta Oecologica*, 29, 283–292.
- Honnay O., Hermy M., Coppin P. 1999b. Impact habitat quality on forest plant species colonization. *Forest Ecology and Management*, 115, 157–170.
- Levenson J.B. 1981. Woodlots as biogeographic islands in south-eastern Wisconsin. In: *Forest island*

- dynamics in man-dominated landscapes (eds.: R.L. Burgess, D.M. Sharpe). Springer-Verlag, Berlin, 13–39.
- Sikorski P. 2002. Przekształcenia szaty roślinnej na przykładzie Podkrainy Zachodniomazurskiej. PhD thesis. Warsaw University of Life Sciences – SGGW, Faculty of Horticulture, Biotechnology and Landscape Architecture.
- Wójcik Z. 1991. The vegetation of forest islands in the agricultural landscape of the Jorka river reception basin in Masurian Lakeland (north-east part of Poland). *Ekologia Polska*, 39 (4), 437–479.